

Center for Advanced Satellite Manufacturing

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Introduction

- History
 - CASM is building upon years of successful space development at USU/SDL
 - On May 4, 2004 the State of Utah awarded USU the Center for Advanced Satellite Manufacturing (CASM)
 - Seed money of \$25,000 was awarded
- The Present
 - CASM is developing and will commercialize state-of-the-art methods and technologies for manufacturing satellites more efficiently and cost effectively
 - Unique intellectual property has been developed and protected
 - \$149,698 is sought for the coming year to support business development and to produce a technology demonstration satellite

CASM Approach

- Apply advanced design and manufacturing techniques to the satellite industry
 - Design Principles
 - Platform Design (Provisional Patent Filed)
 - Design for Manufacturing & Assembly (Provisional Patent Filed)
 - Lean Manufacturing
 - Additive Manufacturing Technologies
 - Rapid Prototyping of Satellite for Design/Assembly Validation
 - Direct Fabrication of Advanced Satellite Structures (Provisional Patent Filed)

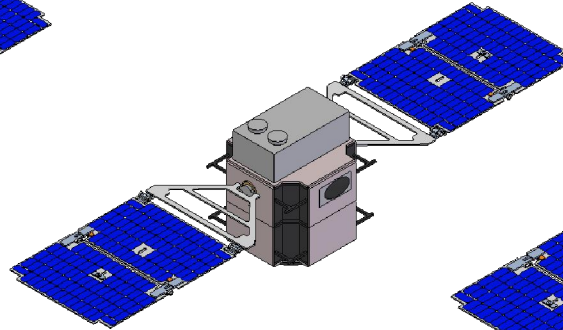
CASM Products and Services

- Small satellites
- Small satellite subsystems, components, and satellite-monitoring ground stations.
- Mission studies (~\$650K of DoD studies last year)
- Consulting Services
- Project Research and Independent Studies
- Space engineering education

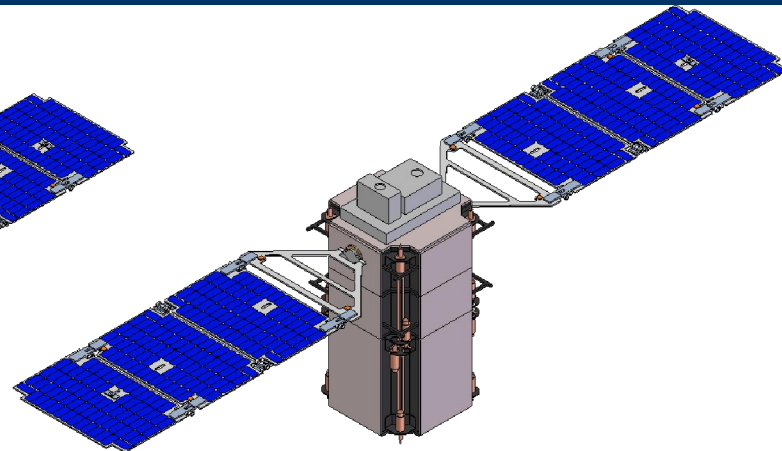
Platform Variants



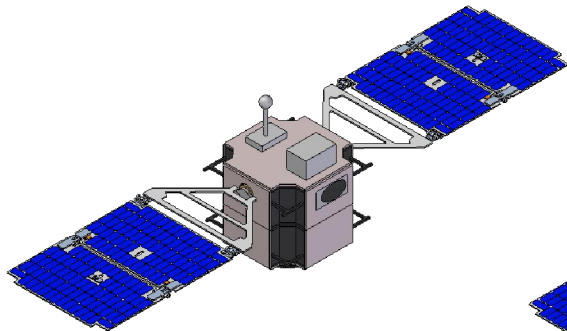
Communications



Remote Sensing



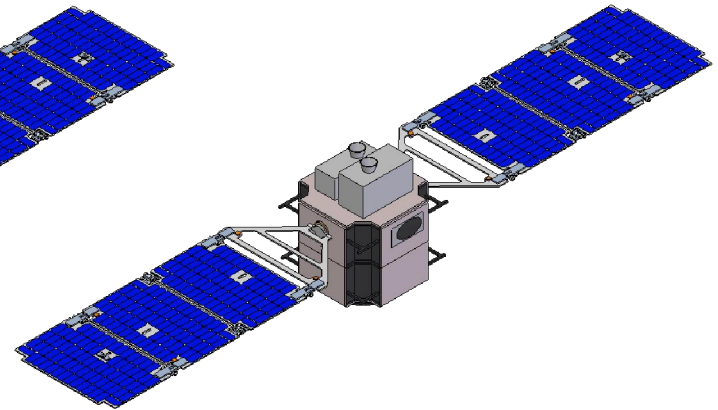
Rendezvous



Science Constellation



Technology
Demonstration

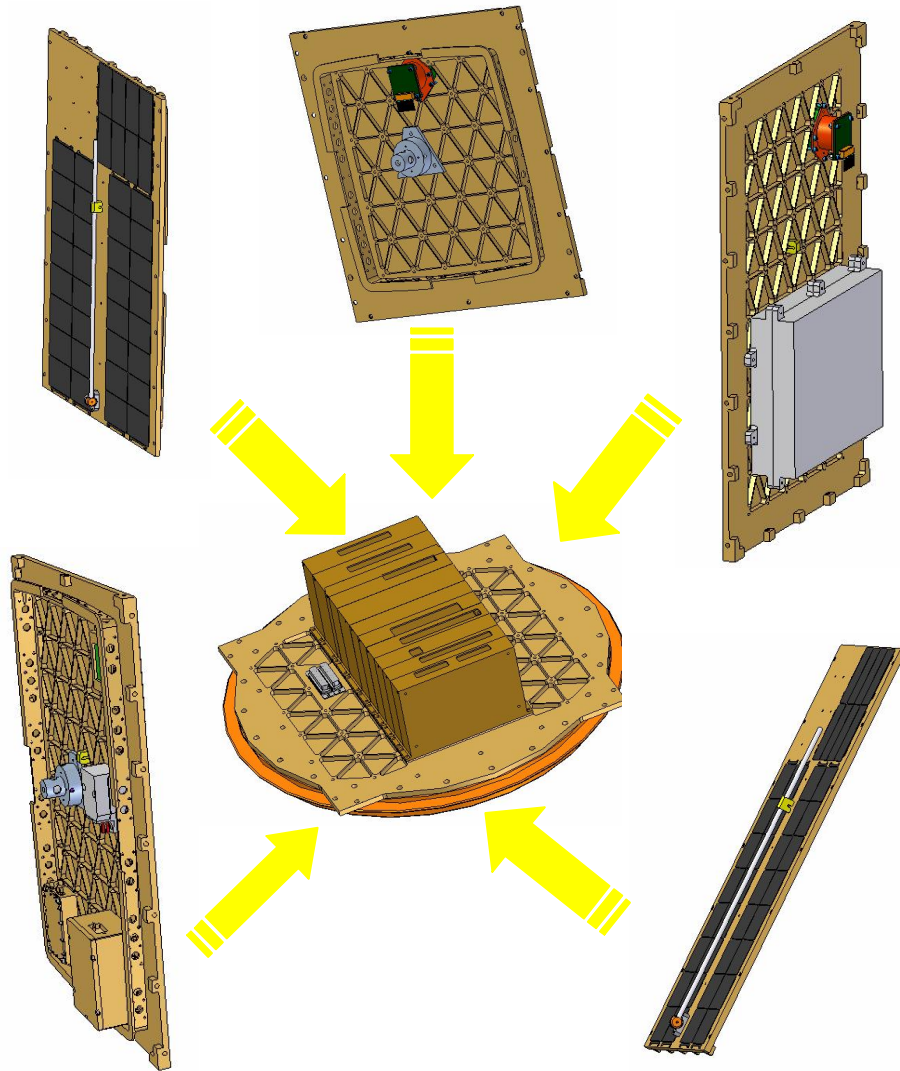


Responsive Space

Evaluation of Platform vs. Custom Design

- The platform design architecture requires some sacrifice in both performance and first-unit development cost
- However, this sacrifice is offset by a reduction in non-recurring engineering costs, risks, and development time for follow-on units
- A platform architecture offers many advantages in addition to cost savings
 - A higher volume production would benefit system integrators, component suppliers, and the launch vehicle industry
 - The use of standards among these higher volume products would benefit the aerospace industry as a whole
 - The introduction of new technologies would be smoother and lower risk by limiting change to individual modules and by utilizing experience gained with previous modules

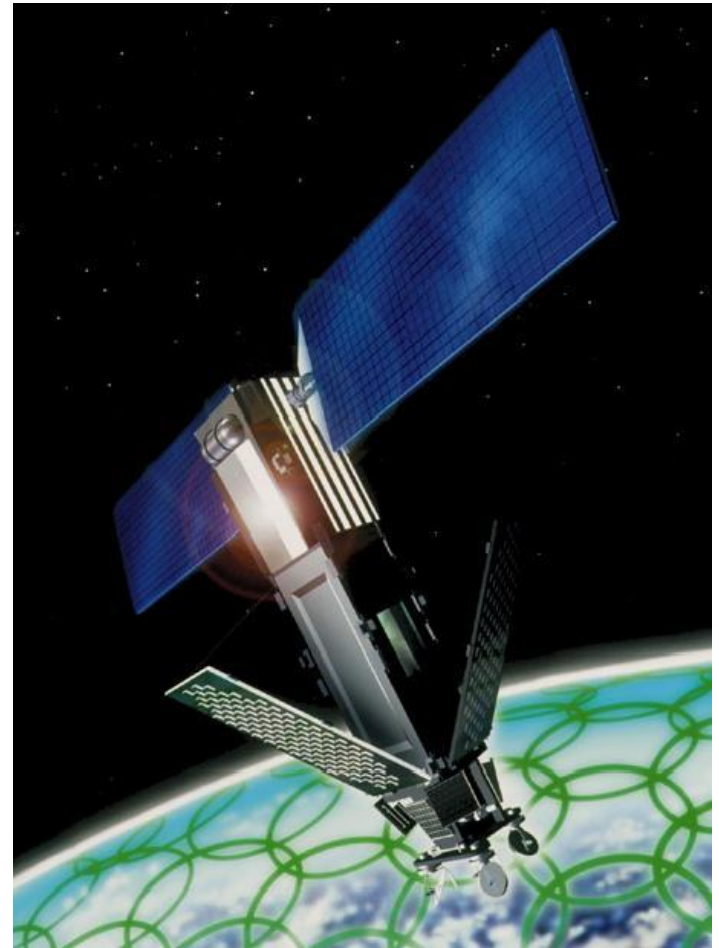
Design for Manufacturing & Assembly



- **Modular Design**
 - Simplifies platform implementation
 - Assembly plan and quality control on each module prior to assembly
 - Individually separable modules to add components
- **Minimize tooling**
 - Adopt universal fasteners, connectors, etc.
 - Universal mounting, testing and assembly interfaces
- **Pre-mounted electrical harness on each module for plug-and-play assembly and disassembly**

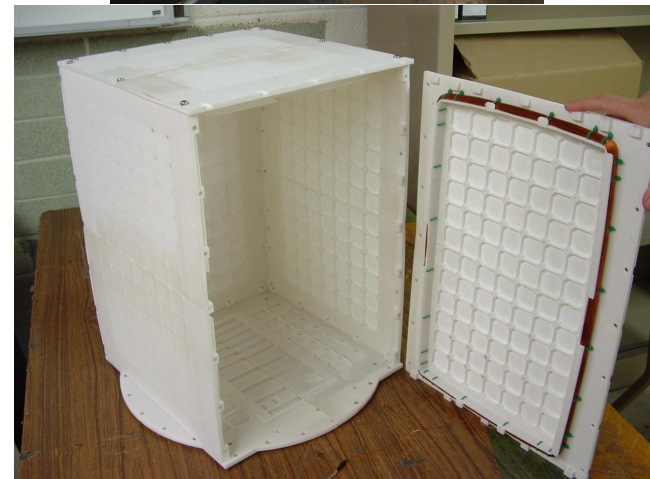
Lean Manufacturing

- Currently studying the application of the Toyota Production System to small satellites
- Access to extensive lean manufacturing experience through the business school (home of Shingo Prize since 1988) and local industry
- Own an Iridium satellite flight spare, perhaps the closest application of lean manufacturing applied to satellites
 - Can study the satellite itself
 - Both Iridium Satellite LLC, the current operator, and Lockheed Martin, builder of the satellites, are helping create a case study
 - Currently on display at the Museum of Idaho as a part of their Idaho Space Journey Exhibit

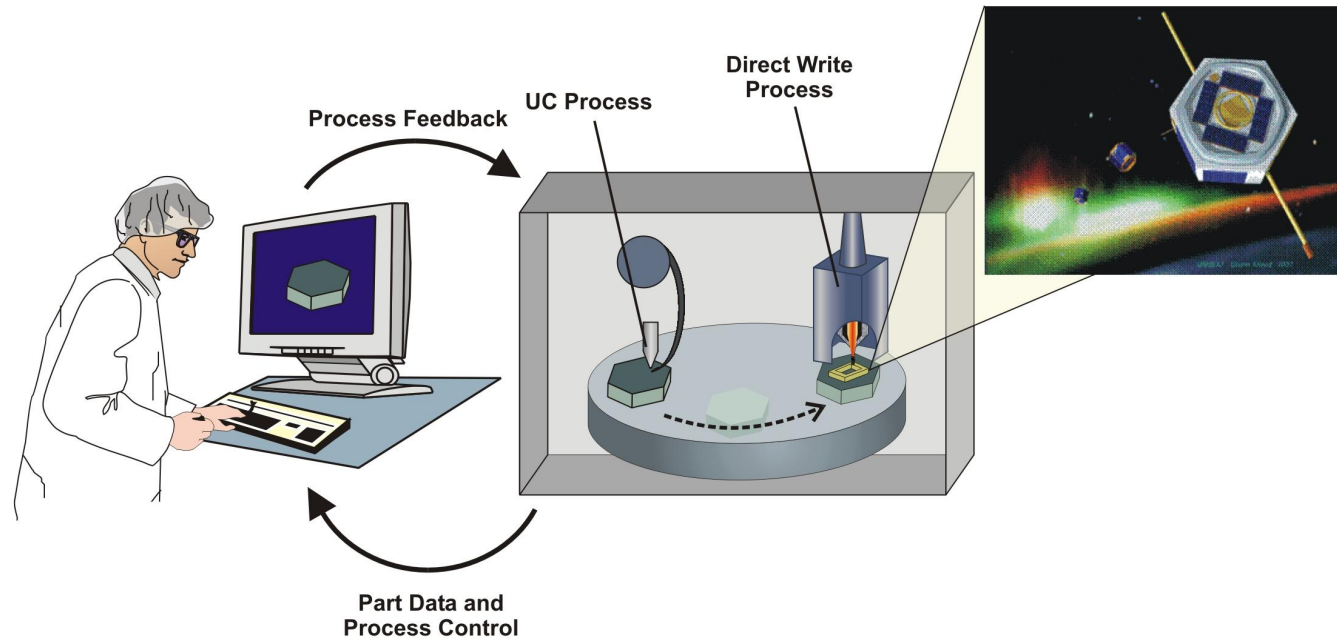


Rapid Prototyping of Satellite Designs

- Quickly prepare a 3-D full-scale or partial-scale prototype of the design
 - Verify CAD
 - Assembly validation
 - Communication to customers
 - Fit check
 - Tooling development
 - ...work out bugs prior to committing to expensive manufacturing processes

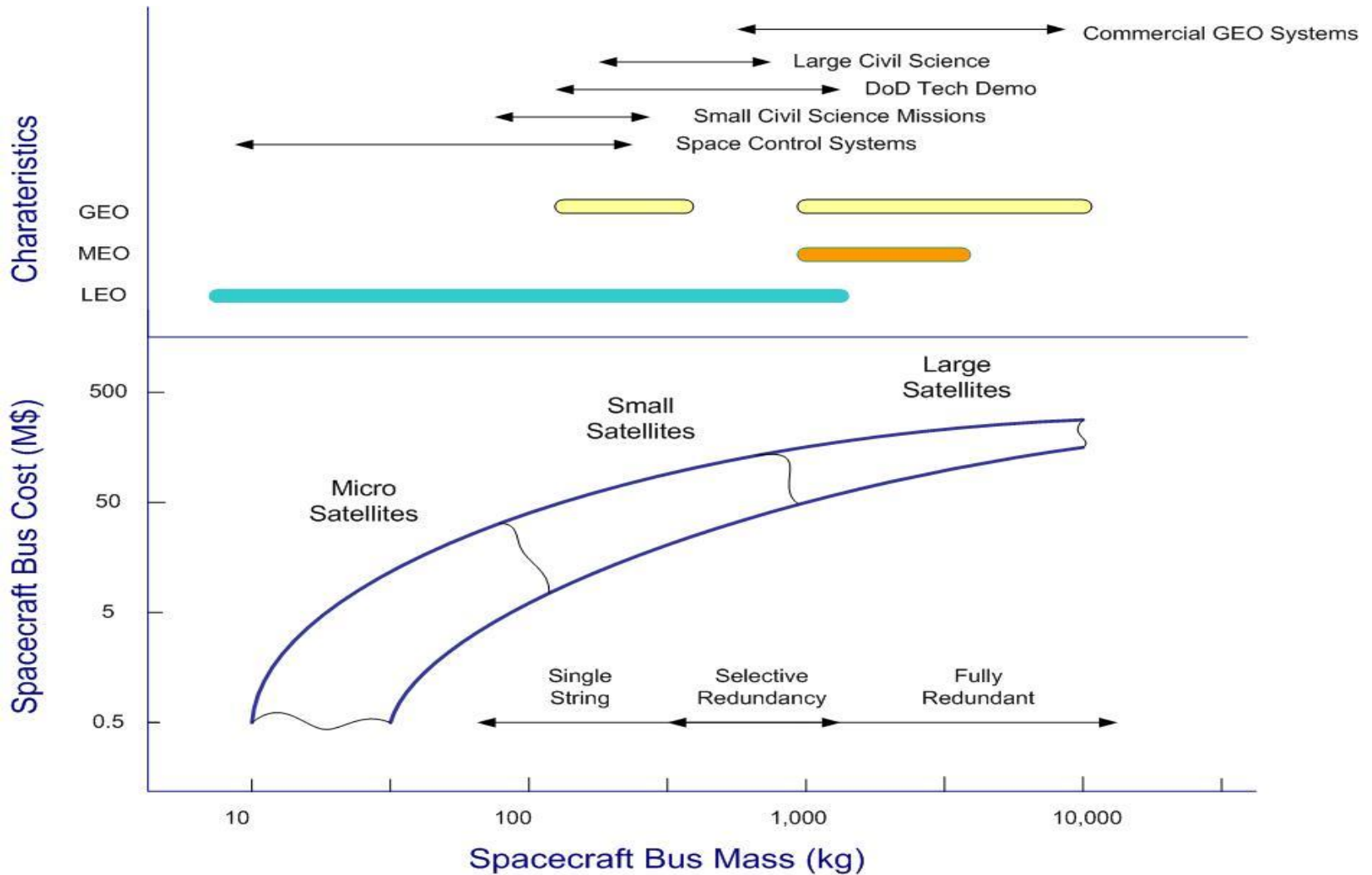


Additive Manufacturing Potential

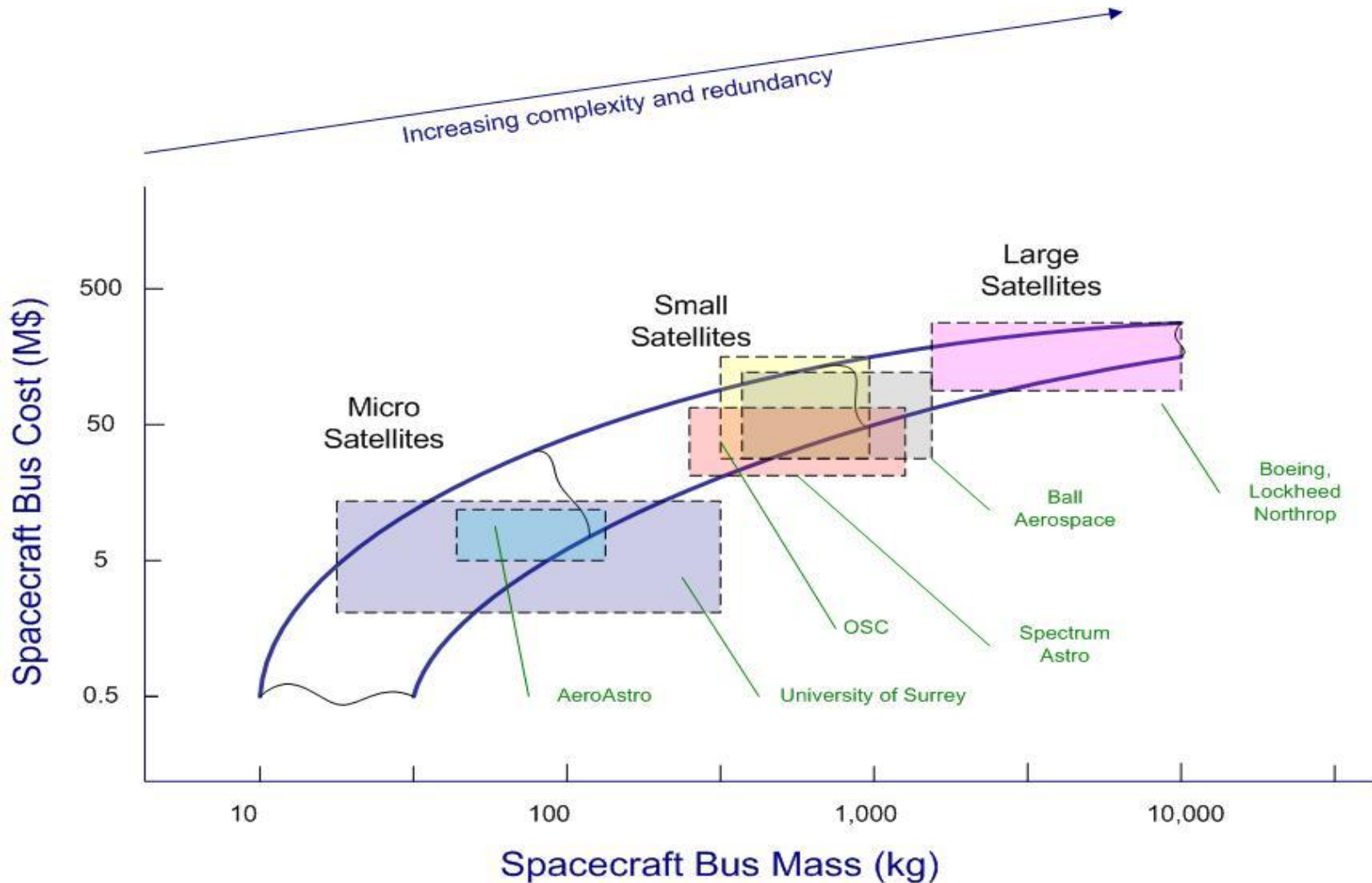


- Additive manufacturing technologies can enable fabrication of advanced satellite panels and modules:
 - Embed electronics, wiring, sensors, fibers and other functional devices within a fully dense aluminum structure
 - Improved quality and reliability through increased automation
 - Shorter lead times due to the inherent reconfigurability of additive manufacturing methods
- Potential recognized with award of an NSF STTR with MSI

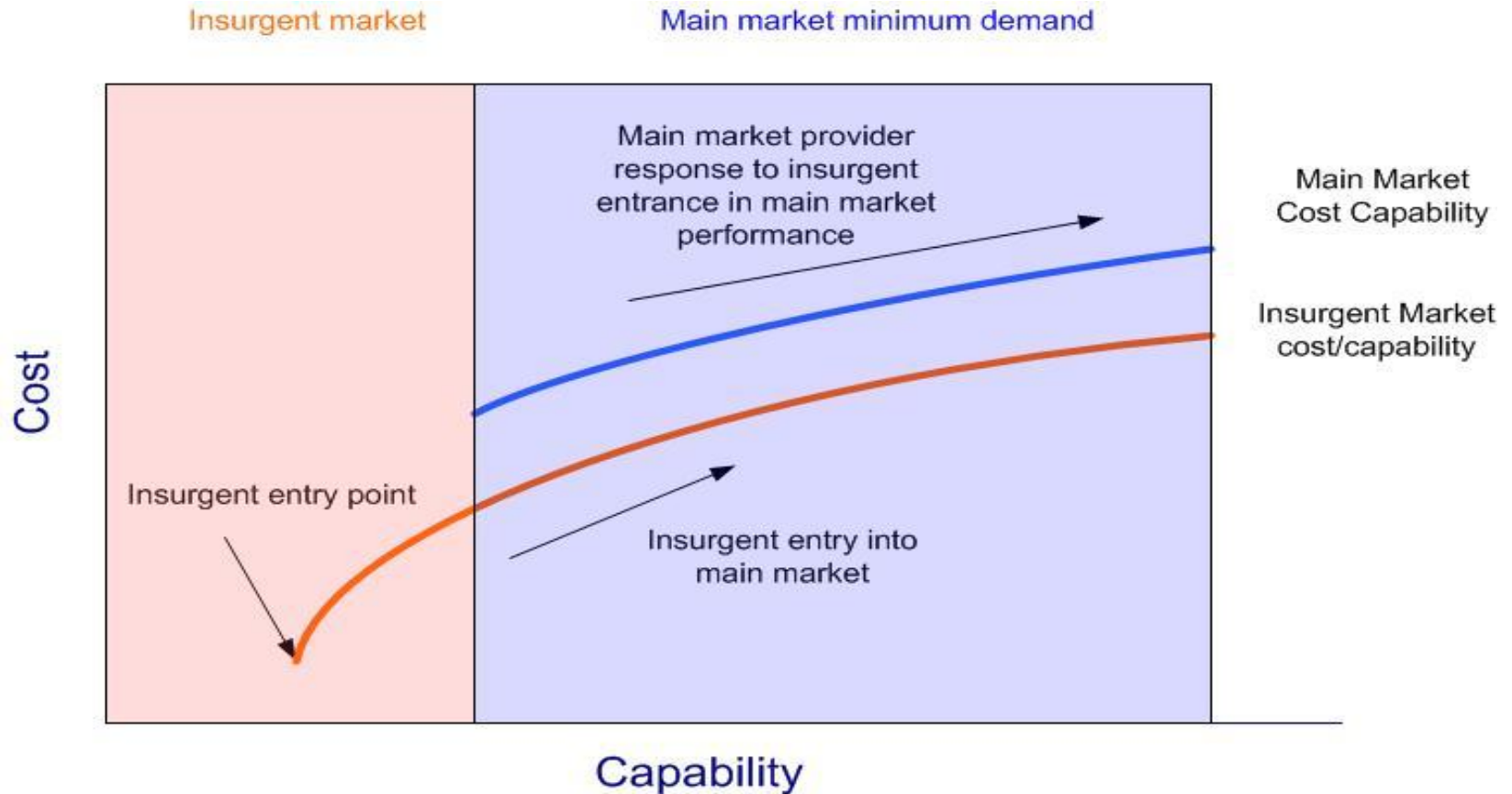
Satellite Market Segments



Satellite Market Competition



Insurgent Market Strategy



□

The Need for Space Control

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The Commission unanimously concluded that the security and well being of the United States, its allies and friends depend on the nation's ability to operate in space. Therefore it is in the U.S. national interest to develop and deploy the means to deter and defend against hostile acts directed at U.S. space assets and against the uses of space hostile to U.S. interests.

- Commission to Assess United States National Security Space Management and Organization, January 11, 2001, chaired by Donald Rumsfeld prior to becoming Secretary of Defense

Satellite Inspection and Rendezvous

As space becomes more accessible for commercial, military, and other government purposes, there is an increased interest to perform visual inspections of both cooperative and uncooperative targets.

1. Commercial

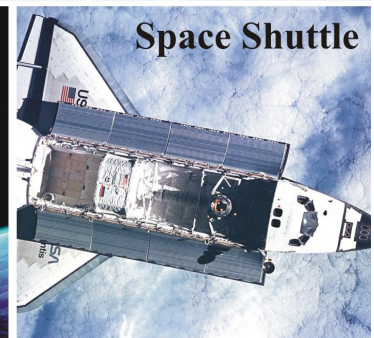
- Inspect malfunctioning satellites to trouble shoot, repair, or refuel
- Inspect launch vehicles to validate performance
- Inspect future space hotels/resorts for maintenance and safety

2. Military

- Ensure international treaties are enforced
- Monitor military's expanding space assets

3. Government Research

- Inspect Space Shuttle for possible external damage
- Surveillance of the International Space Station (AERcam)
- Inspect malfunctioning space telescopes
- Inspect large deployable structures
- Inspect target prior to a rendezvous maneuver



Strategic Partnership

- Lockheed Martin launched the XSS-11 spacecraft on April 11 and it is meeting all mission expectations
- USU, SDL, and Lockheed Martin are collaborating on a classified program in autonomous inspection
- As much as \$450K will be spent this year at USU/SDL on this budding partnership including students interning at Lockheed Martin over the summer
- A strategic alliance is currently being investigated



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Market Research Results

- A small satellite market exists and is large enough to justify pursuit
 - Micro satellite market best point of entry
 - Small satellite market occupied by strong competitors
- Entry strategy is key to success
 - Enter through micro satellite market to establish a foothold
 - Graduate to small satellite market using disruptive technology and techniques
- Organizational issues key to success
 - Adequate capital, facilities, domain experience
 - Need for entrepreneurial leadership and ownership of success

Commercialization Strategy

- Identify small satellite market trends and position CASM to maximize opportunities as they become available.
- Benchmark both successful and unsuccessful small satellite development organizations.
 - Learn from other company's success and failures.
 - Identify profitable market niches.
- Develop strategic partnerships that will help with market penetration.
- Launch an aggressive yet flexible small company that will capitalize on market opportunities.

Market Projections

- Historical satellite prices in the micro class range from an average of \$9.3M to a low of around \$4M. If a conservative one flight per year market projection is accepted, a simple projection of sales can be obtained of either \$9.3M or \$4M per year.
- Another method would be to assume sales similar to the University of Surrey. In 2002 the University of Surrey posted \$22M in sales, while in 2001 they posted \$14M.
- Looking at a possible commercial competitor on the lower end of the scale, AeroAstro had \$6M in sales in 2001 and \$2M in sales in 2000.
- Therefore, a conservative lower boundary can be established so that sales will start no lower than \$2M per year and could easily be as much as \$14M three to five years after the technology is ready for market.

Expected COEP Results

- Historically, focus of USU/SDL small satellite efforts has been on creating hardware and studies that suit a specific customer's needs.
- The COEP funding would allow these efforts to be framed in a larger context of developing a small satellite platform while still meeting these customer's needs.
 - USU/SDL would benefit because they can market their established capabilities to a larger customer base than what is currently being served.
 - The customers benefit from the synergy between efforts giving them more value for their expenditure.
- As CASM technologies mature and are demonstrated, licensing opportunities will be realized (already three patents in progress).

CASM Plan this Year

- Couple NSF-Funded STTR Investigation of Embedded Structures for Satellites with Utah Center of Excellence-Funded Demonstration Satellite Prototype
 - Nanosat ~10kg satellite with many flight opportunities
- Continue to Strengthen Relationships with Local and National Aerospace Industry
- Develop Business Models for Spinning Off Commercialized Technology
 - A dedicated commercial company in Utah
 - Continued strategic partnerships with aerospace industry (MSI, Lockheed Martin, others)
 - Expand opportunities for USU/SDL pursuit of business using USURF infrastructure

Conclusions

- A viable small satellite market exists.
- CASM has a technology advantage.
- CASM is commercially savvy.
- CASM is establishing a track record of success.
- In the January 2005 issue of Utah Business Governor Jon Huntsman, Jr. stated:
 - “All you have to do is visit the Space Dynamics Laboratory up in North Logan and see what Utah State is doing. We’ve got a nascent cluster of aerospace design and engineering happening right under our noses and we don’t even know it. We need to exploit that and be part of the next wave of innovation and development.”